3-25-1837

First Report on the Geology of the Public Lands in Maine, 1837

Maine Geological Survey

Charles Thomas Jackson

SENATE..... .....No. 89.

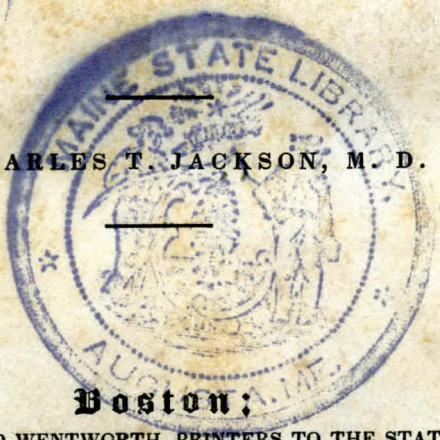
FIRST REPORT

ON THE

GEOLOGY OF THE PUBLIC LANDS

IN THE

STATE OF MAINE.



BY CHARLES T. JACKSON, M. D.

Boston:
DUTTON AND WENTWORTH, PRINTERS TO THE STATE.
Nos. 10 and 12 Exchange Street.

1837.

RESOLVE OF THE LEGISLATURE OF MASSACHUSETTS,

PASSED MARCH 21, 1836.

Resolved, That the Governor with the advice of the Council, is hereby authorized to employ some suitable person or persons to make a Geological Survey of any lands in Maine, where such Survey, together with the various observations which the surveyors will have opportunity to make, will probably lead to a more accurate knowledge of the worth of the public domain.

Commonwealth of Massachusetts.

To the Senate and
House of Representatives :

I transmit to the Honorable Senate, for the information of the two Houses, the first report of the Geologist appointed to make a geological survey of the public lands in the State of Maine, in pursuance of a Resolve which passed the Legislature, 21st March, 1836.

EDWARD EVERETT.

Council Chamber, March 29th, 1837.

INTRODUCTORY REMARKS.

GEOLOGY has for its object the natural history of the earth on which we live. Its name is derived from the Greek γῆ, earth, and λόγος, a discourse, and is understood to signify the doctrine or science of the earth. This science investigates and describes the structure of our globe, the nature of its various components, and the laws, which have effected, and still continue to produce changes in its mass. It aims not only to satisfy the curiosity of the philosopher, but to be practically useful to every one, by pointing out the natural resources which the world offers to its inhabitants. Descending with the miner into the darkest subterranean recesses, it directs, by its light, his operations to their most successful results. It points out with accuracy the structure of the crust of the earth, as far as man has ever penetrated into it, and lays down general laws, by which we may be guided in searching into our great resources in the mineral kingdom.

Thus certain rocks abound in metallic ores, which exist in them in the form of beds or veins; others are always destitute of metallic treasures, but afford in their place a supply of valuable combustibles, in the form of coal. Other rocks contain salt springs, rock-salt and gypsum, which occur in well known formations. There are many rocks also, which are valuable in their natural state, or become so after undergoing certain chemical operations. The situation, quantity and quality of such substances are questions to be decided by a geological investigation.

The architect and engineer derive much valuable information from this science, for it treats of the stability, or liability to change, evinced by exposure of rocks to the action of air and water and fire. It teaches them to avoid those substances which would cause a speedy decomposition of building stones, or deface their beauty.

Soils on which we depend for our daily bread, are known to be formed from the decomposed fragments of rocks, mixed with variable proportions of vegetable and animal matter, and their fertility depends, in a great measure, on the proportions of the mineral ingredients which they contain. The adaptation of soils to particular kinds

of plants, evidently depends on their composition, as most intelligent agriculturalists must have observed. Seeds, which had lain dormant for an unknown length of time, have been made suddenly to germinate and spring up, on treating the soil with particular mineral substances, such as lime, marl or ashes, and have astonished the farmer by their almost miraculous presence on an unexpected spot, where he had not sown the seed in question.

In order to avail himself to the utmost of the capabilities of the soil, the practical farmer should understand its nature, as taught by the geologists and chemists. Then, instead of exhausting his soil, he would continually add to its fertilizing properties. One of the chief reasons why farmers distrust what they call "book learning," as contrasted with actual experience, is found in the fact, that they do not understand the *principles* on which the amelioration of the soil depends. If, for instance, they read in books, or newspapers, that lignite, containing iron pyrites, sulphate of iron, or copperas, is used in certain agricultural districts in Belgium for the purpose of improving a soil, and that great fertility is produced by it, they do not stop to consider the principles on which it acts in that country, and the nature of the soil on which it produces such favorable results, but proceed at once to the trial on their own farms, where the soil, being of a different nature, is, perhaps, rendered totally barren by the very substance that produced fertility in another country. Now in the instance which I have mentioned, which is the result of actual observation, the cause of the difference in the two cases is simply this. In Belgium, where the decomposing pyrites acts so favorably, in the production of wheat and other crops of grain, the soil is composed in a great measure of calcareous marl, which, containing carbonate of lime, exerts a chemical action on the sulphate of iron. An exchange of elements taking place, sulphate of lime, or gypsum, is formed, which is a powerful stimulant to vegetation; while sulphate of iron, or copperas, is a most noxious poison to plants, and when put upon a sandy, or clay and sand soil, destroys by its action the delicate plants, as they begin to put forth.

Some barren tracts of land, in the State of New Jersey, have been rendered fertile, by a just knowledge of the nature and action of a kind of shelly marl and green sand, which abounds in the vicinity. I have seen a sterile tract of red sandy soil, in Massachusetts, suddenly rendered fertile by the application of marl dug up from the

bottom of a neighboring peat bog. In other places an acid peat soil, which was totally barren, was rendered fertile, by carting up a quantity of mud and muscle shells, from the neighboring sea shore. In both these instances, the treatment of the soil was indicated by geological and chemical principles. Let no intelligent farmer, therefore, decry a just and rational theory : for such theories are built upon a multitude of instances, while his own observations, perhaps, are made in a more limited field, and cannot be applied in other situations, where the circumstances are different.

Agriculture may derive a great many valuable hints from geology, while at the same time the geologist should respect the experience of the practical farmer, and learn sedulously from him, the observations which he has made.

The principles of agriculture are at present exceedingly loose and uncertain, and it is on this account that I beg leave to offer the above remarks, requesting each farmer, who has the means of making researches, to experiment rationally in the amelioration of unfertile soils. No one respects more highly than I do this department of human art, and those who are laboring to advance a knowledge of its principles.

By the aid of geology, we are directed to our great mineral resources, which constitute in a measure the basis of national prosperity. Materials useful at all times, in peace or in war, should be found, if possible, within the limits of each State, that it may be prepared for all emergencies.

France was once thrown wholly on her internal resources, and nothing but the skill of her men of science, saved her from being overrun by foreign enemies. By the discovery of an abundance of saltpetre, iron, copper and lead, the genius of Berthollet, Monge, and their compeers, supplied her with the immediate means of successful defence ; while their discoveries, recorded in the archives of science, have served to aid in the defence of other countries, and among them our own during the war with Great Britain. Every State that discovers within itself the means of support and defence, strengthens by that means the whole confederacy.

Besides the immediate advantages resulting from the discovery of new substances, within the limits of the State, we may consider those arising from the check, which is given to absurd speculations in pretended valuable minerals, which may exist only in the imagination of

the schemer. Maine has suffered so much from such extravagances, that I need not enter into the details of many absurd instances, which crowd my memory. There are few individuals in the State who cannot relate many examples, which have come to their knowledge, of digging and boring for coal in primitive rocks, where it never exists—of working iron pyrites, under the supposition that it was gold or silver—of selling polished specimens of greenstone trap-rock, under the idea that it was marble, and many other such vain speculations, which have taken place, from ignorance of geology. Such absurd operations are by no means confined to Maine; they are carried on in almost every part of our country, and injure public confidence, in all proposals, to explore our mineral wealth.

Some of the instances which have come to my knowledge, were evidently fraudulent artifices, but a greater number proceeded from ignorance of the nature of the substances in question.

Every citizen of Maine feels, I doubt not, that the throng of wild speculators, who crowded the State summer before last, have injured public confidence in the real valuable resources of the State, and produced a corresponding retardation in the business and settlement of the country. Had a geological survey been made a few years earlier, this difficulty would have been prevented, so far as relates to the mineralogical resources of the State. In the course of a short time the reaction of public feeling will subside, and people will look seriously into the real mineral wealth which your State so abundantly contains, and successful operations will be commenced so as to ren der it available.

I have spoken of a few of the ordinary uses of geology, by which it appears that many of the arts and manufactures are benefitted, and human wants supplied. There are, however, higher and nobler uses appertaining to this science. It opens to us the great book of nature, where we may read the eternal truths of creation, those "sermons in stones" which were written by the finger of the ALMIGHTY, and which bear indisputable proofs of his wisdom, goodness, power and omnipresence.

The world has its history written on its strata; a history so interesting, that the most splendid fictions of the human imagination sink into insignificance when compared with it, in the same measure as all human productions must, when compared with the eternal works of the Creator.

First Report on the Geology of the Public Lands, belonging jointly to the States of Massachusetts and Maine.

His Excellency EDWARD EVERETT,
Governor of Massachusetts:

SIR,

In accordance with the instructions contained in a commission, which I had the honor to receive from you on the first of July, 1836, I have made a reconnoissance of a portion of the public domain, for the purpose of ascertaining the nature and position of the various rocks, minerals and soils, existing in those regions, and beg leave to offer the following report.

From the nature of a geological survey, it is evident, that a limited district, cannot be fully understood without exploring the country to a considerable distance around, in order to ascertain the mutual relations of the rocks, and their relative positions with regard to each other. Were the labors of a geologist confined exclusively to the public lands, it would be impossible for him to determine the relative ages, order and position of the strata which there exist; for, besides the almost insuperable difficulties presented, by the trackless thickets of the forest, and the deep covering of decayed vegetable matter, and soil that hide the rocks to a great extent, there are other obstacles appertaining more directly to the subject of his inquiries. The position in which the stratified

rocks are placed, with regard to the unstratified, can only be learned by tracing the two rocks to their points of contact. Fossils characteristic of the age of strata, are not scattered in a uniform manner through their mass, and the geologist may have occasion to travel a long distance in order to discover the true medals, which record the chronology of the formation.

To illustrate this remark, I will suppose a geologist called upon to assign the geological age of the conglomerate rock, composed of various pebbles cemented by an argillaceous paste, which exists in the town of Roxbury near Boston. If he searches ever so carefully in that place, he will fail to discover any characteristic fossils, by which he could identify the formation with any European equivalent, and there are no mineralogical characteristics in that rock, which will infallibly determine its age, for there are conglomerates of similar pebbles of all ages. Nor would he be any more successful in his endeavours to ascertain the age of that rock, by its place in the order of superposition, for there is no locality in that town where the fact can be determined.

It will be easy however, for the geologist to decide these important questions, by researches in some other places, where this rock extends in a regular manner, and discovers the nature of its fossils and the rocks on which it reposes.

By continuing his researches towards Rhode Island, he would find the strata, including beds of anthracite at Mansfield, accompanied with a kind of shale or slaty wacke filled with impressions of plants, characteristic of the coal formation; and at Rhode Island, he would meet with petrified madrepores or corals, which would confirm

his views respecting the age of the rocks in which they are found.

At Bridgewater, and in Brighton and vicinity, he would discover the strata of clay slate rocks on which the conglomerate rests, and by following these rocks he would presently discover the primary rocks on which the whole series repose. Long journeys and careful observations, reiterated many times, are then necessary to fix the relative age of a rock formation existing in a limited district. All persons conversant with geology, will perceive the important results, that are necessarily brought about by such researches, and that they are intimately connected with subjects of vast economical value, for the discovery of coal and many other valuable minerals are among the advantages which flow from such scientific investigations.

I have premised the above remarks to shew that much light is to be cast upon the geology of the public lands, by a careful survey of other portions of the State of Maine and of the bordering British province of New Brunswick, into which we are obliged to make occasional excursions while tracing out the position of strata. By means of information obtained in a private survey of the province of Nova Scotia, undertaken in 1827–9, by Mr. Alger and myself for scientific purposes, I was able to trace bituminous coal formation through that province, to the Grand Lake in New Brunswick, where it has since been explored, and is now soon to be extensively wrought by a Boston company. This coal formation, it will be seen by this report, extends onwards toward the public lands of Maine, and I have traced it distinctly to the Tobique river which empties itself into the St. John. At St. Andrews, N. B., and at Perry in Maine, the red sand-stone

which belongs to the coal measures also exists, but it is not yet decided what is its relative position with respect to the bituminous coal. This question can only be decidedly answered, by making a direct section from that place to the Grand Lake on the St. John, which will be done in the course of the survey for Maine.

Those who feel desirous of understanding the particular geology of Maine, are referred to the report made to the Legislature of that State. In the present essay, I shall confine myself wholly to the public lands, and shall, as we proceed in our researches, generalize the particular facts and details, which enter into a special report. Only a single month has been devoted to the public lands, yet, as will be seen, many useful observations have resulted from our researches, and the value of the public property will be enhanced by the facts discovered and detailed in the course of the survey. Many of our citizens who own property in the wilds of Maine, are wholly unacquainted with the nature and value of their possessions, while others have erroneous notions respecting the nature of the soil and climate of those regions, by which they are prevented from making a profitable investment and use of such property.

At a time when the boundary line between the British Provinces and the United States is proposed to be drawn, it is certainly a matter of no small importance that we should know accurately the nature and value of the district in dispute.

All the essential particulars respecting the nature, extent, and value of the mineral treasures of the useful rocks, soils, and many facts concerning the physical topography of the country, and the nature of the agricultural and manufacturing opportunities which are afforded,

will become the objects of my study while engaged in this survey, and will be communicated to the Legislature of this state in the form of annual reports, or otherwise, if desired. At the close of our researches, a General Report may be drawn up from the particular discoveries detailed in the annual communications which will then form a comprehensive work, including all the essential facts of general interest.

Plan of the Survey.

In exploring a country, covered with a dense growth of forest trees, I felt some embarrassment in forming a good plan for methodical observations. I had already traversed the woods of Maine sufficiently to know that it is no easy matter to penetrate her trackless forests, and that even when it is practicable to penetrate the thickets, but little satisfactory geological information can be obtained, on account of the deep unbroken soil, and coverings of dead leaves that hide the rocks from view.

On this account, I proposed to make my attack upon the rocks, by following the river courses and torrents that cut across the general line of strata which traverse the State, and by exploring carefully the ravines in the sides of mountains. In effecting a general survey, or reconnoissance of the country, I have succeeded beyond my expectations — the summer, having been remarkably dry, afforded me excellent opportunities for examining the beds of rivers where the current had lain bare the rocks, so that a perfect section of great extent could be distinctly examined, and the direction and dip of all the strata noted and recorded.

The St. Croix River was followed to its source, and

then the St. John River, which traverses the public domain for the distance of three or four hundred miles, and below the Grand falls, runs within from two to eight miles of our boundary line, afforded an excellent opportunity for tracing a right line section across the strata, and then for observing the extent of the rocks in a westerly direction.

The Aroostic, meandering directly through the public lands, and sweeping, by large curvatures, through an enormous extent of country, also affords an excellent opportunity to penetrate into the very heart of the unbroken wilderness, and will give access to strata in almost every direction, while it will lead within a narrow canoe portage of the Penobscot, down which, we can proceed in making our course through the public lands.

Were it not for the existence of these great rivers, where canoes may transport us from one region to another, it would be impossible to make a geological survey of that portion of the State in a satisfactory manner, illustrating the researches by collecting specimens of the various useful substances which are among the objects of such an exploration.

Under the most favorable circumstances, this geological survey is one of great difficulty, and requires much foresight and skill for its accomplishment.

Those who have never engaged in such pursuits, are hardly able to conceive how numerous are the hardships, privations, and dangers to which the geologist is exposed in exploring such regions. He is obliged to prepare everything as for a campaign in war—to paddle the bark canoe amid rapids, rushing over sunken rocks—to wield the sledge-hammer and pick-axe, and to carry in his knapsack the specimens which he collects, together with his

food, and clothing, and tools. Fatigued with his labor, loaded with instruments and specimens, he tracks his way by the compass many miles through the woods, stumbling over fallen trees, or bemired in the midst of a swamp, or forcing his way between the thickly crowded cedars, whose interlocked branches obstruct his progress, and shut out the light of day.

Exhausted by fatigue, he sits himself down beside some brook or spring, spreads his tent-cloth, if perchance he has one—and building a camp fire, partakes of a scanty meal, and reposes at night beside the fire, upon a heap of spruce boughs for a bed.

There is, I must confess, some romantic interest in such scenes, but it is severely chastened by hard labor; and but few would feel willing to renew them, after having gone through them one campaign.

During our survey the past autumn, we were not exposed to the tormenting black flies and musquitoes, owing to the lateness of the season, but in the summer months they are very annoying to travellers in the forests.

I have enumerated a few of the difficulties which we have to contend with, in order that it may be distinctly understood that our duties are of an exceedingly laborious nature, for many persons who read a report, or hear lectures, have no idea of the labor and fatigue by which the facts were obtained

The district which I propose to describe, is the North-Eastern boundary of the United States, a district of great extent and value, which is now contended for by the two governments, of Great Britain and the United States. This disputed territory is about as large as the State of Massachusetts, and is the most valuable timber land in the State of Maine. It is also remarkable for the excellence

of its soil, equal in richness to that forming the valleys of the Ohio and Mississippi, and capable even under a comparatively cold climate of producing an abundance of wheat and other grain. While engaged in the geological survey of Maine, we explored a great extent of sea coast between Thomaston and Eastport, and determined the relative ages and position of the various rocks which occur along the sea board. We also made many excursions inland, and examined very carefully those places which appeared to be of commercial value.

Superposition of Rocks.

The order of superposition we may state in the following manner, beginning from below, and enumerating the layers upwards in geological order.

1. The lowest rock of an unstratified nature, is the greenstone trap, which is seen in numerous places cutting through the granite and sienite, below which it evidently originated, and was forced up through rents in the superincumbent rock. The epoch of its elevation through the strata, is ascertained to have been after the formation of granite, and before the tertiary formation was deposited. It is seen to repose on the new red sandstone, through which it has passed, thus demonstrating its protrusion to have been since the formation of that secondary rock.

2. Porphyry rocks also exist abundantly, and were thrown up in dikes, through the transition slate rocks anterior to the elevation of the trap.

3. Granite and sienite rocks nearly, if not quite coeval, form the next gradation in the series, and these rocks are proved to have been thrown up since the deposition of

the transition argillaceous slates, which they have affected in a remarkable manner evincing the action of heat.

4. Thus it is not improbable that gneiss, mica, and talcose slates are metamorphic rocks formed by the action of granite on regular strata.

This series of rocks generally rests on granite, and they not unfrequently pass into that rock by imperceptible shades.

5. The transition argillaceous slates and limestones rest upon talcose and micaceous slates, the latter being considered metamorphic varieties of the former rocks.

Porphyry is observed cutting through these transition rocks in the form of dykes, and must therefore have originated below them; and, since these dykes are not found higher up in the series, they must be regarded as having been elevated before the deposition of the secondary strata.

They are traversed by dykes of trap, and must therefore have been formed before that rock. By means of such a series of geological axioms, we have fixed the age of the various rocks on the coast of Maine.

The tertiary formation, consists of clay, marl, sand, and pebbles. It contains shells, and occupies a position, showing that it was deposited from water on the various subjacent rocks.

Diluvial blocks, pebbles, sand, gravel, and clay, mingled in confusion, attest their origin and deposition amid the waters of the deluge.

The alluvial deposites produced by the washing down of fine materials from the hills around, form the meadow intervales and the rich soils along the river banks.

I offer the above generalizations, which I do not by any means consider as final decisions merely to avoid minute details in the present report. You are referred, for

such details, to the Topographical Geology, in my report to Maine. It would be irrelevant to repeat them here, since the districts in question do not appertain to Massachusetts.

Along the banks of the St. Croix, occurs a variety of sandstone, (commonly called freestone) exactly like that found in Nova Scotia, and along the banks of the Connecticut in this State. This sandstone appears to be the new red sandstone which belongs to the gypsum and salt deposites in other countries, and generally overlays coal.

In this place, however, no coal has yet been found, and but one salt spring has been discovered. From the observations which we were able to make, it appears that this rock reposes on a transition argilio-ferruginous limestone, remarkable for the abundance of its fossil shells, some of which certainly are characteristic of the transition formation, while others are new species undescribed.

This sandstone, which is so situated, contains but few fossils, principally fuci or marine plants. It has alternate beds of grey sandstone, such as occurs in the coal mines of Cumberland, N. S. This sandstone is evidently a secondary rock formation.

By means of future researches, I intend to trace the position of the coal bearing strata to the Grand Lake, N. B., and shall decide the question as to the relation of the red sandstone of the St. Croix.

Having determined to make a section of the strata in a northerly direction from Calais to Houlton, and from thence along the banks of the St. John River to Madawaska, we engaged a strong wagon to transport our effects through the woods by the route of the Calais and Houlton road.

This road is in many places almost impassable, and the traveller is constantly obliged to have recourse to his axe,

in removing fallen trees that obstruct his progress, or to make use of a lever to raise the wagon over obstacles in the way. The distance from Calais to Houlton, by this road, is about 84 miles. The bad roads to which I refer are in those districts that belong to colleges and academies exempted from taxation; while the road is passable, and in some places very good where it passes through private property or state lands.

Immense advantages would accrue to Calais and Houlton by improving this communication between the two places.

Proceeding on the route above mentioned, we travelled slowly, examining the rocks in every accessible situation, and collecting specimens of the minerals and soils for examination. Around Calais, the rocks are granite, sienite, and a coarse hornblende rock, consisting of large crystals of hornblende and felspar, in a state of confused aggregation. Valuable granite quarries exist in the vicinity of this town, near Bog brook, and are now extensively wrought for architectural purposes. The granite found along the Calais road is not fine or suitable for quarrying. Hornblende rocks abound for a considerable distance, and then we came to argillaceous slate, which crops out near Lewis Pond, twenty miles from Calais, and is intersected by intruded dykes of greenstone trap rocks. We were informed, that slate suitable for roofing exists at the Grand falls of the St. Croix, but had not time to visit the locality.

At Lewis Pond there is a very good inn kept by Mr. Simpson. The road to this place is good, and an excellent bridge crosses a branch of the river.

Passing over this bridge, we entered the Indian Township, the wood on one half of which has been burned, and

still remains standing. The soil appears to be excellent, and the rocks are slate. The road was good until we arrived at Mr. Gleason's, thirty miles from Calais, where it is rough for three miles, as it cuts through the corner of Talmadge. I remarked also, that the road was laid down erroneously on the map of the public lands, and have corrected it as far I was able, as will be seen on the map which I have prepared. The rocks are slate, and the soil is good, derived from the decomposition of the rock in this place, and from an admixture of diluvial sand formed from decomposed granite. Boulders, or rounded masses of this rock, were observed on our way, and have evidently been transported from the north, where we soon found them in place on No. 8, near the Baskenhegan Lake. On the shores of this lake we observed also slate rocks in place. Mr. Anderson furnished us with accommodations at his house, near Jackson Pond, forty-two miles from Calais. After examining the shores of the lakes without discovering any very interesting geological appearances, we continued our journey to Mr. William Butterfield's, fifty-four miles from Calais, and from thence we explored the vicinity of the Grand Schoodic Lake. Limestone and bog iron ore are said to occur on the banks of the Mattawamkeag, west from Butterfield's, but we did not go thither to explore it, as it would have taken up more time than could be spared from the public lands. After passing Butterfield's there is no road. The trees are felled so that a light wagon may lumber slowly through, but we found it extremely laborious to effect a passage with a double wagon. After going on three or four miles, the road becomes more passable, and on reaching the ridge called the Horseback, it is very good all the way to Houlton.

This ridge is extremely curious, and consists of sand and gravel, built up exactly like the embankments for rail-roads, the slope on either side being about thirty degrees, while it rises above the surrounding low lands to the height of thirty feet, its top being perfectly level and wide enough for two carriages to pass abreast. Its surface was originally covered with maple, birch, and hard pine trees, while the low lands, on either side, are covered with a dense growth of cedars. I could not help thinking, as I looked upon this natural embankment, that it would be easy for an antiquarian to mistake this ridge for a work of art, and to suppose that some of the aboriginal inhabitants of our country knew how to annihilate distance by rail-roads. My first impression respecting the geological origin of this embankment, was, that it was alluvial, and formed the bank or intervening shores of two lakes, which existed in the low tracts, now covered with cedars; but on examining the nature of the materials, of which it is composed, I became satisfied, that it belonged to the formation of transported clay, sand, gravel and boulders, which is called diluvium, consisting of the loose fragments of rocks, that were transported by a mighty current, the last time the waters prevailed over the land. The occurrence of similar embankments at Houlton, served to confirm this opinion; for there they have the same north and south direction—a coincidence so remarkable, that it could not be the result of chance. The Horsebacks of New Limerick and Houlton are much more elevated, and some of them are said to rise to the height of ninety feet. Those which I examined, however, were not more than fifty feet high. It will be noticed, that many of the fragments of rock, which these diluvial accumulations contain, are similar to the slaty lime-

stone found farther to the north, and up the St. John river. I cannot stop now to speculate on the causes of this transportation of loose materials, but I may say, that there are abundant proofs, on the whole face of this continent, that there has been a mighty rush of waters over its surface, from the north and northwest, and that such a current has swept over the highest mountains of Massachusetts. *(Vide Report on Geol. of Mass. by Prof. Hitchcock.)*

On the road from Calais to Houlton, the traveller will continually observe, that the loose and rounded stones, which lie upon the soil, are not similar to rocks that occur beneath it, but that they can be identified with rocks, from which they doubtless originated, farther north. By a series of observations, it is possible to ascertain the limits of diluvial transportation; but in this section of country my efforts failed to prove satisfactory, on account of the dense forests and the covering of soil, which concealed the rocks in place, so that I could not feel certain of my results. I know of no such observations having been made elsewhere, but it seems reasonable, that it can be approximated, with some degree of accuracy, by taking into consideration all the conditions of the problem. On our way from Butterfield to Houlton, we discovered an abundance of black oxide of manganese and iron ore, on the road side, and imbedded in rocks in place. After our arrival in Woodstock, I had the pleasure of discovering an enormous bed of this ore, which runs directly towards the spot, where we had picked up the specimens above mentioned.

The soil from Calais to Houlton is generally good, and bears a luxuriant growth of maple, birch, hemlock, spruce, and pine trees, while the low lands are thickly crowded

with cedars. The geological nature of the soil is of three kinds, diluvial, alluvial, and soil resulting from the distintegration of the rocks, beneath; and it is not unfrequent to find all these varities on the same farm. The mineralogical nature of the rocks, producing soils, explains their origin. We have then, a soil derived from granite, of a yellow color, containing grains of quartz, mica, and felspar, while the chief part of the latter mineral, is decomposed into clay. Soil derived from argillite, is of a blue color, and contains fragments of slate. Alone, it forms a tenacious clay, and cold soil; but when mixed in due proportions with the detritus of granite and limestone, it forms a good soil. Limestone soil of this vicinity, is of a brownish yellow color, mixed with blue particles of slate. Houlton is remarkable for her limestone soils, which are extremely luxuriant, and admirably suited for the growth of wheat, other grain, and grasses. They are very deep and warm, and always kept loose and spongy, by the small fragments of slate, which they contain. There are also rich alluvial soils in this place and at New Limerick near by, which yield to no other districts in the luxuriance of their productions.

After exploring in a hasty manner, the most important places around Houlton, in which we were kindly assisted by the politeness of Mr. Carey, who resides in Houlton, and is well acquainted with the localities, we set out for Woodstock, on the British side of the line, and there met with kind attentions from Major Ketchum, whom we had seen in Houlton. This gentleman afforded us much aid in our enterprize, which we are happy here to acknowledge. While in Woodstock, I saw some specimens of red slate, covered with black oxide of manganese, which I instantly recognized as the matrix of the

hæmatite iron ore; and on expressing my opinion that iron would be found at its locality, I was conducted thither, and discovered an enormous bed, not less than fifty or sixty rods wide, and extending towards the district I have described at Hodgdon. This bed of iron ore forms the summit of a hill, and is favorably situated for working the metal, charcoal being easily obtained at a low price. The ore will yield not less than fifty per cent. of pure iron, and sixty per cent. of cast iron. It is the most easy ore to smelt in the blast furnace, and is not difficult to break, nor will it overload the furnace. Situated near an important military post, this bed of iron ore is of national importance, and should not be overlooked by government. Should the ore ever be wrought, it ought to be remembered that the Tobique River has on its banks a plentiful supply of red sandstone, suitable for making the hearth and lining of a blast furnace, and will also afford limestone required for a flux in smelting the ore. It is not a small advantage to have these indispensable articles on a river up stream, so that they may be brought down, at a trifling expense, in boats or on rafts.

Having engaged our passage in a horse tow-boat, we set out for the Grand Falls, carrying our provisions and camping apparatus with us, and travelling slowly up the St. John's river, at the rate of 15 miles per diem, so that we could have leisure to explore the banks of the river, by walking along beside or in advance of the boat, and putting our specimens on board when it stopped. In the vicinity of Woodstock, large dykes of trap rocks are seen cutting through the slate and limestone, and running in an E. N. E. and W. S. W. direction. We found the strata every where visible, as they were exposed by the river, which was low at the time, and disclosed their outcrop-

ping edges. We noted the direction of the limestone and slate in many hundreds of places along the river's banks, as we proceeded, and found it to be E. N. E. and W. S. W., and the dip W. N. W. Many dykes were observed, cutting through the limestone, with veins of calcareous spar accompanying them. Fossil shells, such as terebratulæ and trilobites, were found, but they are rare along the river's course. Large and perfect specimens of terebratulæ were found in blocks of grey limestone, which we traced to their origin on the Tobique River.

Masses of red sandstone occurred also in abundance, as also did large pieces of beautiful red jasper, carnelian and chalcedony, which were mixed with rounded and water-worn pieces of amygdaloidal trap. All these minerals we traced to the Tobique—not a specimen being found after we passed above the mouth of that river. The occurrence of red sand-stone, in erratic blocks, along the course of the St. Johns, served to satisfy me, that the coal measures were some where in the vicinity ; and I am of opinion, that this substance may be found between the Tobique and the Grand Lake, on the St. John. We know that it has been found at the latter place, and there is a good prospect of its being found continuous to the Tobique ; for there, that formation exists, and a powerful bed of gypsum has been found, embraced in the new red sandstone at that place. I had previously predicted that this formation would strike the St. John at this point, and hoped to have found it on the western side of that river, but it has not yet been observed extending so far. There is, however, no impossibility of its existing on the public lands, west of the St. John, for there are frequent interruptions in the extent of the coal measures, and an inde-

pendent coal basin may as well occur there, as on the opposite side of the river.

No fragments of sandstone were observed in the bed of the Aroostic at its confluence with the St. John, all the transported masses of rock found there, consisting of stratified blue limestone and argillaceous slate. If it should happen to be the case, that the direction of the sandstone strata, is such as to confine it to the eastern side of the St. John River, it would then, if continuous, extend to the lands belonging to Maine and Massachusetts, north of the Grand Falls, and will be found on the range of highlands, forming the northern boundary of the State. In a future excursion, I propose to trace the known coal-bearing strata of New Brunswick, up the St. John, from the Grand Lake coal mines to the Aroostic; and thence, if the strata are found to be continuous, following their course until they intersect the public lands.

It is certainly a very important fact, that there are large beds of gypsum on the Tobique River, for that substance is well known to be exceedingly valuable in agriculture, and it can be brought down the Tobique and the St. John, to any point required, on the public lands which lie along the St. John, within from two to six miles of the river, while it would be impossible to bring the Nova Scotia gypsum up the river, on account of the expense of freight, which would cause its price to rise so high, that it never could be afforded for agricultural purposes. It may also be remarked, that gypsum is not subject to any custom-house charges, and boats are not subject to tonnage duty; so that the Tobique gypsum is just as valuable to the State, as if it occurred within the limits of Maine.

The rocks along the course of the St. John, up to the Grand Falls, consist entirely of stratified blue limestone

and slate, which are traversed by numerous dykes, and the rocks rise, in some places along its banks, to the height of from 200 to 300 feet above the river. Much of this limestone, I have no doubt, will furnish excellent hydraulic cement, a similar rock being used for this purpose in Quebec. On the Aroostic, good limestone, for the manufacture of lime, abounds, and much of that on the St. John, will answer for the same purpose. Iron ores also occur on the Aroostic, within the limits of Maine, and about six miles from the boundary line. The details of our observations on this river, will be seen marked on the map which I have prepared. It will be remarked, that there are high banks of diluvial soil resting on the rocky banks along the river, and that the whole track along its course to the Grand Falls, possesses an uncommonly fertile soil, covered with an abundant growth of forest trees, of every kind found in the State. This river, below the falls, is broken by numerous and powerful rapids, through which it is extremely difficult, and sometimes dangerous to pass in a boat. The most remarkable of these rapids, are at the Presque Isle, Tobique, and Salmon Rivers, and between the Salmon River and the Grand Falls, the two latter being called the *Rapid de Femme* and the *Rapid Blanche*, both of which are dangerous and difficult to pass with boats.

The present mode of towing heavy flat bottomed boats, by means of horses, wading along the banks of the river, is exceedingly tedious; but owing to the rapidity of the current, and the presence of rocks, breaking the surface of the water, there is little prospect of steamboats ever being used in the navigation of the river above Woodstock.

The Grand Falls are produced by the falling of this river over high ledges of slate and limestone rocks, where

it makes a sudden turn in its course. This cataract is a most magnificent waterfall, and tumbles by a series of three successive leaps over the rocks, to the distance of 125 feet, with a tremendous crash and roar, while it rushes through its high rocky barriers, and whirls its foaming waters along their course. When the sun's rays fall upon the mist and spray, perpetually rising from the cataract, a gorgeous iris is seen floating in the air, waving its rich colors over the white foam, and forming a beautiful contrast with the sombre rocks, covered with dark cedars and pines, which overhang the abyss.

Sir John Caldwell has just erected a saw-mill beside this waterfall, and has constructed a railroad of timber across the high promontory of land, so as to transport the deal boards and logs from the mill, and to the river below the falls. Although it is sometimes agreeable to see the useful combined with the beautiful, I do not suppose that lovers of the picturesque will imagine the beauty of the falls enhanced, by the erection of saw mills by its side; nevertheless, if they prove advantageous to the public, we must yield in matters of taste, to the demands of commerce. There is, however, nothing repulsive in the appearance of these works, and they may be shut out of the view, if found to detract from its interest. Travellers, who may visit the Grand Falls, will find many very magnificent scenes, which are peculiar, and will interest even those who have seen the more stupendous cataract of Niagara. We are indebted to Sir John Caldwell for many polite attentions, which we beg leave here to acknowledge.

Having engaged two Acadians to carry us up the St. John to the Madawaska River, in their birch bark canoes, we set out on our voyage, and examined the shores on

either side of the river, as we proceeded slowly up against the current. The St. John is much broader above the falls than it is below, and there are but few rapids, and none of them dangerous to the canoes. The boundary line is but three miles west of the falls, and was marked by the surveyors who ran the line seven or eight years since. The whole tract between the Madawaska and this line, is settled by Acadians, and is known under the name of the Madawaska settlement. This district was incorporated as a town, by the State of Maine; but difficulties having ensued, as to the right of jurisdiction, it was agreed to leave the place *in statu quo*, until the claims of the two countries should be adjusted; an injunction being placed, by mutual agreement, against cutting of the timber upon the disputed territory. It is well known that Maine regards the usurpation by the British authorities, as unjustifiable, her unoffending citizens having been seized and committed to prison, on no other pretence than their endeavor to carry into effect the laws of the State to which they belonged, by calling a town meeting. We met with Mr. Baker at the Grand Falls. He was one of the persons arrested at the Madawaska town meeting, and was subjected to the indignity of a foreign jail. This gentleman gave us much information relating to the timber districts of Madawaska, and the means of transporting the timber down the St. John River.

The population of Madawaska settlement, is estimated at three thousand souls, nine hundred of whom dwell above the Little falls. Most of the settlers are descendants of the French neutrals or Acadians, who were driven by British violence, from their homes in Nova Scotia, (called by the French, Acadia,) on the 17th of July, 1775.* These

*See Halliburton's History of Nova Scotia.

people at first established themselves above Fredericton, and subsequently removed above the Grand Falls, and effected this settlement. The Acadians are a very peculiar people, remarkable for the simplicity of their manners and their fidelity to their employers. Although they are said to be "sharp at a bargain," they are remarkably honest, industrious, and respectful; and are polite and hospitable to each other, and to strangers. It is curious to observe, how perfectly they have retained all their French peculiarities. The forms of their houses, the decorations of their apartments, dress, modes of cookery, &c., are exactly such as they originally were in the land of their ancestors. They speak a kind of *patios*, or corrupted French, but perfectly understand the modern language, as spoken in Paris. But few persons can be found who understand or speak English, and these are such as from the necessities of trade, have learned a few words of the language. None of the women or children either understand or speak English.

The Acadians are a cheerful, contented, and happy people, social in their intercourse, and never pass each other without a kind salutation. While they thus retain all the marked characteristics of the French peasantry, it is a curious fact that they appear to know but little respecting the country from which they originated, and but few of them have the least idea of its geographical situation. Thus, we were asked, when we spoke of France, if it was not separated from England by a river, or if it was near the coast of Nova Scotia; and one inquired if Bethlehem, where Christ was born, was not a town in France! Since they have no schools, and their knowledge is but traditional, it is not surprising that they should remain thus ignorant of geography and history. I can account

for their understanding the pure French language, by the circumstance that they are supplied with catholic priests from the mother country, who, of course, speak to them in that tongue. Those who visit Madawaska, must remember that no money passes current there but silver; for the people do not know how to read, and will not take bank notes, as they have often been imposed upon, since they are unable to distinguish a £5 from a $5, or five shilling note. As there are no regular taverns in this settlement, every family the traveller calls upon, will furnish accommodations, for which they expect a reasonable compensation; and he will be always sure of kind treatment, which is beyond price. I have been thus particular in speaking of the Acadian settlers of Madawaska, because little is generally known of their manners and customs; many people having the idea that they are demi-savages, because, like the aboriginal inhabitants, they live principally by hunting. Owing to the injunction placed on the timber lands, ten families of the Acadian settlers have emigrated to Michigan Territory. It is very desirable that this obstacle to the prosperity of the people of Madawaska, should be removed by an adjustment of the present difficulties, respecting the North Eastern boundary of the State.

The geology of Madawaska is simple, and not very interesting; the rocks consisting of argillaceous slate and blue limestone, which is covered with a deep and luxuriant soil, bearing an abundance of cedar, pine, spruce, birch, maple, hemlock, and other forest trees, which abound in these regions. A few beds of plastic clay were observed, suitable for pottery and brick making; one of which is situated on the north bank of the river, eighteen miles above the Grand Falls, and four miles

above the residence of Captain Tiberdot; another occurs on the same side of the river, opposite Grand Island, and near the Green River. This latter bed is interesting, on account of its containing lignites, which are evidently remains of cedar trees, completely penetrated with a beautiful blue earthy phosphate of iron, which may be used as a pigment. A fossil unio was also found in this clay. Below the plastic clay, occurs a bed of pisolitic iron ore, and beneath this a stratum of green sand, which may be used with lime for a manure. The cliff rises thirty feet abruptly from the river, and presents a section of the variously colored blue, brown and green strata.

Slate rocks, suitable for roofing, occur three miles above Green River, on the north side of the St. John, where they form a precipice thirty feet high, and extend along the river one-fourth of a mile. Hills, composed of the same kind of rocks, occur on the southern side of the St. John.

At the mouth of the Madawaska River, slate rocks are again seen, and run E. N. E. and W. S. W.—and stand in vertical strata. The Madawaska falls over these rocks, to the distance of five or six feet. It would be practicable to convert this fall into a valuable mill privilege, but a dam must be built to the height of twelve feet, since the St. John, during freshets, is crowded with water, which overflows these rocks to that height. The Madawaska River is thirty-five miles above the Grand Falls of the St. John.

After examining, as far as we were able, along the banks of this river, amid snow storms, while the thermometer stood below freezing, we were compelled to return, on account of the snow, which covered the rocks and soil. The river had nearly reached the freezing

point, and our clothes were covered with ice, while the snow fell abundantly in our canoes. Descending the St. John, the canoes glided with great ease and rapidity, and we soon found ourselves at the Grand Falls; and transporting our canoes over the land, we again set out, on the river, to Woodstock, from whence we took passage to Houlton, and carried with us five boxes of specimens of rocks and minerals, which we had collected on our route.

The following Thermometrical Register was kept during the last days, while we were on the river:

At Madawaska,	Oct. 18—Temperature of the air at noon,	33° F. Snow storm; violent wind; water froze on our garments.
	" " " of the river,	38° F.
	" 19—Half-past 6, A. M., temp. of air,	25° F.
	" 20— " " 8, " "	32° F.—Rain and snow.
	" 21— " " " " "	28° F.—Snowed a little.
	" 22— " " " " "	28° F.—Snow.
At Grand Falls,	" 22— " " " " "	34° F.
	" 22—9, P. M., temp. of air,	36° F.
	" 23—" " " of river,	33° F.

Before closing this section, I would remark, that it is of the greatest importance to the State, that the boundary question should be adjusted, as soon as possible, for not only is the timber, on the disputed territory, plundered on a large scale, but it is also in many places necessary to have it cut, before it is ruined by decay. I was informed by Mr. Baker, that on the district of St. Francis, where a fire has killed the foliage, there are no less than ten to twelve thousand tons of very valuable pine timber, which is now fit for use, but which in a few years will be good for nothing, unless it is cut down to prevent its rotting. Although there is a prohibition against cutting timber on the public lands in dispute, it is no secret that this law is evaded.

From the observations of persons, who are in the habit of rafting logs of timber down the St. John, it will appear that the current of the river above the Grand Falls,

is from one to three miles per hour, while below the falls, it runs at the rate of from three to six miles per hour, the swiftest current being at the rapids, and in the narrowest parts of the river. When the snows of winter begin to melt from the mountains and high lands, the St. John rises with great rapidity, and frequently the water accumulates, during freshets, to the height of thirty feet above its ordinary level, so that the rocks at the rapids are entirely submerged, and the banks of the river are overflowed in many places. When the ice breaks up in the spring, it is said that this river presents a sublime spectacle, the ice being crowded into a narrow space, and heaped up sheet upon sheet, in an enormous mass, so as to arrest the passage of the water, when it accumulates and finally overcomes the opposing barrier, moving it forward with a noise like thunder, and sweeping down every obstacle in its course. Rocks, frozen into the ice, are thus transported down the river to a great distance, and even carried out to sea. It is probable that most of the large masses of sandstone, trap-rock, jasper, and carnelian, found a little above Woodstock, are thus brought down from the Tobique, and deposited along the banks of the St. John, fifty or sixty miles below. Moving ice is a powerful cause, modifying the surface of the earth, and probably was one of the means, by which the various scattered blocks of stone and boulders of large size, were transported to a distance, during the last grand deluge that overwhelmed the globe.

On our return from the St John, we passed by the military road from Houlton to Bangor, and had but few opportunities of exploring the rocks on our way. We observed, however, that the limestone and slate rocks, alternating with each other in regular strata, run as far as the Forks

of the Mattawamkeag, where we lost sight of them, the whole surface of the rocks being covered with diluvial and alluvial soil, on either side of the road.

In the town of Lincoln, we saw some large and beautiful blocks of granite which were quarried in that place, but we had not time then to visit the locality. The soil along the whole extent of the military road, is deep and rich, consisting of disintegrated particles of limestone and slate, which are known to form an excellent soil for wheat and other grain.

While engaged in a private survey, before entering upon my public duties, I explored the slate region of Williamsburg and Brownville, situated 40 miles N. N. W. from Bangor; where an inexhaustible supply of roofing slates may be obtained. The Williamsburg quarries are situated on Whetstone Brook, a branch of Pleasant River, and the rock forms a precipitous bank to the stream. The slates are divided into regular sheets, standing in a nearly vertical position, the dip being 85 degrees north, and their direction east and west. It is difficult to say, whether the divisions coincide with the stratification or not, there being no other rocky strata alternating with the slate. From the uniformity and extent of the divisions, it seems probable, that they are the lines of stratification. By driving a chisel between the layers of this slate, sheets of a perfectly even surface may be split off with great ease, which are of suitable thickness for roofing, and from two to five feet square. When struck, the slates ring like those from Wales, and are perfectly free from cracks. Not the least trace of pyrites, or other substance, calculated to cause the disintegration of the slate, is found at this quarry, and I have no doubt, that it will be wrought to advantage. Access to this locality is at

present difficult, owing to the forests which surround it. Whetstone Brook, it is said by Mr. Greenleaf, may easily be cleared of rocks, and rendered navigable to boats during freshets. I should think it far more expedient to lay an ordinary rail-road, supported on timbers, from the quarry to Pleasant River, the distance to navigable water being two or three miles. On the side of a hill, a little west of this quarry, occurs another good locality of excellent slates, which may be split into very thin sheets. I found that I could obtain fifty-four distinct and perfect slates from a slab one foot in thickness.

The Brownville slate is situated 200 rods N.E. from Pleasant River, and forms a steep precipitous hill, rising from 100 to 120 feet above that river, and having a steep descent to its banks, the intervening land being at present covered with forest trees. This locality is inexhaustible, and the slate is of an excellent quality, containing no pyrites, and is capable of resisting, as may be seen on its exposed surface, the action of air and water for ages, without undergoing decomposition. The sheets of slate were observed to run E. by N. and W. by S., and they dip N. W. 70 degrees. Slates, from one to six feet square, may be split with great ease from this rock, and in any quantity desired. A great natural advantage is presented at these localities, by the nearly vertical position of the srata, while they occupy elevated ground, and may be transported to the river by a regular slope of the land, a railway being made for the distance, which is only 200 rods. So valuable a locality should not be allowed to remain unwrought, and I am happy to learn that it is in contemplation to begin operations at this place early next summer. While at this locality, some calculations were made respecting the cost of transporting the slate;

and from data, furnished by gentlemen well acquainted with the navigation of the Penobscot, it appeared that it could be landed in Boston, at the cost of eight dollars per ton. Now the Welch imperial slates sell for twenty-seven dollars per ton, and this locality will furnish an equally good article. I feel no hesitation in saying, that, in my opinion, Maine is capable of supplying all the United States with good roofing slates. The whole section from Williamsburg to Bangor, appears to be composed of argillaceous slate; I have observed it on either side of the river below that city. Doubtless, other quarries will be found equally valuable with those of Williamsburg, but I have not yet visited any which can be wrought so advantageously.

From the observations which we have been able to make, during a short campaign of one month in the public lands, it will be seen, that the district in question is remarkable for the great extent of the limestone and slate rocks, which abound over a large tract of country, and furnish valuable materials for the manufacture of lime and roofing slate, while the soil, resulting from the disintegration of such rocks, forms a most luxuriant soil for the cultivation of wheat and other grain, and is remarkable for the abundance of vegetation which it supports.

Several varieties of the limestone will, doubtless, serve for the manufacture of hydraulic cement, a substance of great commercial value, and which will hereafter be required in constructing various subaqueous works along the banks of the numerous rivers in those regions.

Potters' clay, marl, iron ores, of various kinds, also abound, and will hereafter become valuable, as the settlement of the country advances.

The soils are of so rich a character, that they are evi-

dently destined to attract the attention of the inhabitants towards agriculture, and will amply reward the labors of the husbandman. Now a heavy growth of pine timber, spruce, maple, birch, and various other forest trees cover this soil, and constitute the chief part of its present value. But the time must come, when the soil itself will be considered of vastly greater value than the timber now growing upon it; for it is a soil admirably adapted for agricultural purposes, and will produce abundant crops of wheat, and other valuable grain. It is also a rich soil for various grasses, and for the cultivation of potatoes and other culinary vegetables. Thus far Indian corn has not been successfully cultivated, on account of the short duration of summer; but it can be raised by planting early corn from seed obtained in northern regions, and will soon habituate itself to the climate.

The whole aspect of the country indicates that the employments of future settlers will be in agriculture and the various manufactures, the numerous great rivers that traverse the country supplying water power for the movement of machinery.

I discovered a large and valuable bed of iron ore in the vicinity of Woodstock, which can be wrought profitably, and will furnish an abundance of that indispensible metal, while the smelting of the ore will produce a great demand for charcoal, which will be supplied by the luxuriant forests on the public lands.

It is highly probable, that future researches will bring to light other beds of this valuable ore on the public lands, which may engage the enterprise of our countrymen in its manufacture.

The occurrence of a powerful bed of iron ore, yielding 50 per cent. of iron, close to our frontier, and running di-

rectly across the boundary line, near one of our military posts at Houlton, is a discovery of national importance, for we are obliged, at great expense, to transport heavy cannon and balls over land to that place, while the articles so essential in a fortification may now be produced on the spot.

This ore is the compact red haematite, and will yield 44 per cent. of pure iron, or about 50 per cent. of cast iron. Allowing its specific gravity to be equal to 3.5, and some of it will range still higher, a cubic foot of the ore will weigh = 200 pounds.

From the surface exposed above the soil, it appears that this bed is no less than 900 feet wide, and its length is yet unknown.

From the above data, we may calculate the quantity of ore and of metal that may be obtained in working this mine to a given extent.

Let us suppose that the bed should be wrought to the length of 500 feet, and 100 feet in depth. By calculation we can form an approximate estimate of its cubic contents. We have only to multiply its width by its length and depth, to learn the number of cubic feet which it contains—thus:

$900 \times 500 \times 100 = 45{,}000{,}000$ cubic feet of ore.

Then every cubic foot weighing 200 lbs. we should have,

$45{,}000{,}000 \times 200 = 9{,}000{,}000{,}000$ pounds of ore;

which, yielding 50 per cent. of cast iron, will give,

$$\frac{9{,}000{,}000{,}000}{2} = 4{,}500{,}000{,}000 \text{ pounds of cast iron,}$$

which may be obtained from this bed within these narrow limits!

On the Tobique river, occurs a fine red sandstone at the Red Rapids, which may be brought down the St.

John, and used for constructing the lining of the blast furnace; and limestone, which is required for a flux, is abundant in the vicinity, the best kinds occurring on the Aroostic and on the Tobique rivers. Charcoal is so cheap in the regions which I am describing, that it may be advantageously used; and the iron manufactured with such a material is far more valuable than that made with bituminous coal or coke, for the sulphur generally contained in the latter coals is liable to contaminate the iron, and render it "hot short," so that bar iron, made from it, is brittle under the hammer.

It is not improbable that bituminous coal will be found on the Tobique, and between that river and the Grand Lake, where it is now wrought. If this opinion should prove true, it may then be used in the iron works proposed for the manufacture of cast iron, while bar iron may be made in Bloomery forges, heated by means of charcoal. Thus two kinds of iron may be produced.

Among the products of the forests I would mention the fact, that the people of Madawaska obtain all the sugar which they use from the native rock maple, (*acer saccharinum*,) which grows in great luxuriance on the public lands. Not only are their domestic wants in this respect fully supplied, but a considerable quantity of sugar is sold to the timber-cutters, and to the people residing along the St. John. This article they retail at 10 cents a pound in its crude state. It is of a dark brown color, and when put into tea renders it nearly black, owing to the oxide of iron which it contains,—this substance being derived from the iron kettles in which they concentrate the syrup.

Hemlock bark, an article largely used in tanning leather, may be obtained in any desired quantity on the public

lands. It will not be profitable, however, to transport the bark itself to market, but, by a very simple process, all the tannin which it contains may be extracted, and it may then become a valuable article of commerce, for its bulk is small in proportion to its value, and the expense of transportation to market will be trifling.

In conclusion I would remark, that the public lands of Maine possess one great advantage over the western territories of the United States, in the fact that the whole region which we have visited is remarkably healthy, and totally free from those fatal emanations or miasms that arise along the banks of rivers, and on low lands, in the western country. No intermittent fevers here ever chill the blood; and, although the settler may not enjoy so long summers as in a more temperate climate, he will at least feel that he runs no risk of troublesome and dangerous endemic diseases, to which he would be there exposed.

Mr. James T. Hodge, Assistant Geologist for Massachusetts, and Dr. T. Purrington, Assistant Geologist from Maine, accompanied me in the survey, and performed diligently and faithfully the duties assigned them.

Mr. F. Graeter, draftsman for the survey of Maine, also accompanied us to the Grand Falls, and drew many beautiful sketches of geological and woodland scenery of the State. Some of the drawings which illustrate the public lands, I hope to be able to have engraved for a future report, and I shall also present a geological map of the territory, when we have collected a sufficient number of details to complete, in some measure, the plan which I have proposed to fill up. I have already drawn upon a map of the St. John River, an exact account of the strata which are disclosed on its banks, and have made many topographical corrections in the map of the public lands. at

would be premature to publish these drawings at present; but they will be presented when they are more complete.

Should it be the pleasure of the Legislature to continue the survey, I shall devote myself, for part of the season, to the territory through which the Aroostic and Penobscot wind their way, and the next annual report will contain many important facts which will result from the comparative analysis of soils. This branch of agricultural science has been almost wholly neglected in our country, and the evils of unscientific experiments in this art are too manifest to require comment.

Instead of empyricism, we require scientific directions in our agricultural researches, and the more light we have upon the subject, the greater will be the advantages offered to the practical farmer.

We have already made a collection illustrating the geological origin of soils, by which they are traced back to the rocks from which they originated, and the subject is found to be one of much practical interest. This collection, I believe, is the only one that has yet been made, in our country, to illustrate this important subject.

Origin of Soils.

Soils are derived from the disintegration and decomposition of rocks, and there is usually an admixture of decayed vegetable matter on the upper surface, which adds much to their warmth and fertility.

There are various kinds of soil found in the State of Maine, some of which are the immediate results from the decay of rocks in place, while others have been transported from a distance, by the action of running water. Where a soil is derived directly from the rocks in place,

every stage of its passage may be observed. From the solid rock, we trace small fragments which have been shivered by the action of frost, or by the agency of the atmosphere and water, have undergone decomposition, it being converted into a perfectly fine soil, in which it is difficult to recognize the materials from which it is derived.

In soils resulting from the decomposition of granite or gneiss, we discover particles of quartz, and brilliant scales of mica, while the felspar is observed in the form of opaque earthy-looking grains, of a white color.

Slate rocks form a blue soil, full of small fragments of the rock, which are easily distinguished.

Argillo-ferruginous limestone forms a light yellow soil, and is generally penetrated by rootlets of plants, to a considerable distance from the surface. This soil is luxuriant, and is preferred to all others for the cultivation of wheat, barley, and the grasses.

Greenstone trap decomposing, produces a brown colored soil, remarkably warm and luxuriant. In Maine and Nova Scotia, it is found to be the best soil for potatoes.

New red sandstone, when disintegrated, forms a red sandy soil, containing particles of mica. Alone, it is not considered fertile, but when mixed with the trap-rock soil, it is very good. Specimens illustrating the origin of soils, are deposited in the collection, which I have prepared for the State of Maine.

Besides the soil formed from rocks in place, we have the transported soils, which are those that have been removed by running water. Alluvium is produced by the continual action of rain, springs and rivers, upon the loose materials found on the hills and mountains, which materials are carried by running water to the plains, and

are deposited along river courses, especially during freshets. Soils of this character are composed of fine particles of rocks, which are deposited in the state of mud, mixed with a small quantity of vegetable mould. They are well known as the most luxuriant and valuable of soils, and form the rich bottoms of meadows, and the low banks of rivers. Their fertility depends upon the fineness of the transported materials, and upon the due admixture of the several mineral substances, which they contain. Where alluvial soil is formed entirely from slate rocks, it consists of a tough blue clay, which, alone, is not genial to vegetation. Where it is deposited by a rapid current, the particles are of a coarser nature. A mountain torrent leaves only heavy stones in its course, while the smaller fragments are carried to a greater distance, and deposited exactly in the ratio of their smallness, at a distance from the parent bed. Where a rapid stream carries down the detritus of granite rocks, it will leave only large stones and grains of quartz on its way, the lighter particles being carried down the stream and deposited where its current is less rapid. During freshets, rivers overflow their banks, and spread out over the country, and not being confined to their narrow channels, their rapidity is diminished, so that they deposit as they go, an abundance of rich loam, brought down by the river. It is thus, that the Nile, Ganges, Mississippi, and Ohio enrich their banks annually with new soil. The Penobscot, Aroostic, and Meduxnekeag, in Maine, also deposite a deep alluvium on their banks, which, were the climate as temperate, would equal in fertility, the richest alluvial tracts of the Western States.

Few regions in the world can boast of more extensive and well watered alluvial districts than are found in

Maine. At present public attention is chiefly turned to the heavy timber, which covers the soil along the banks of these rivers, but there can be no doubt, that the soil itself is worth vastly more than the timber, and will be of many thousand times more real value in the course of its agricultural improvement. Houlton, and the region extending through the public lands, along the Aroostic, and down the branches of the Mattawamkeag, and Penobscot, are the richest agricultural sections of Maine, much of the soil being alluvial, while even the diluvium there is made up of the debris of limestone, the whole forming a rich and deep soil.

The currents of rivers and torrents transport fragments of rocks to a considerable distance, and some modern geologists suppose, that they are able thus to account for the dispersion of all erratic blocks of stone, which are scattered over the country, far from their parent beds. From the evidence which I have been able to collect in various parts of our country, I feel no hesitation in saying, that the course, in which these erratic boulders are scattered, is far too uniform to have resulted from local and partial currents, like those of torrents or rivers. All the observations that have been made, tend to prove that a current of water has swept over the surface of the globe, since the consolidation of all the rock formations, and the deposition of the tertiary marls and clay, and that the current swept along with it, the loose masses of stone and gravel and sand, carrying them from the north or northwest toward the south or southeast. Thus was formed the accumulation of rounded masses of stones and gravel and clay, which constitute what is called, by geologists, diluvial soil. It is supposed that this rushing of water over the land, took place during the last grand deluge, ac-

counts of which have been handed down by tradition, and are preserved in the archives of all people. Although it is commonly supposed that the deluge was intended solely for the punishment of the corrupt antediluvians, it is not improbable, that the descendants of Noah reap many advantages from its influence, since the various soils underwent modifications and admixtures, which rendered them better adapted to the wants of man. May not the hand of Benevolence be seen working, even amid the waters of the deluge?

Diluvial soils are common in Maine, and are in many places very deep, and bear on their surface an abundant growth of forest trees. I have already described some of the most remarkable localities—the Horsebacks around Houlton, and the rounded hills of Augusta.

There are too many localities to admit of particular description, almost every town presenting examples of this formation. It should be remembered the diluvial soils and rocks may generally be traced to their parent beds, north or northwest from the place where they occur; and by a series of observations on the surface of our immense continent, I doubt not that the limits of diluvial transportation may be ascertained, since there are extensive tracts of one kind of rock, bounded by an equal extent of another, and the transported masses may be referred, at once, to their parent rocks. I suggest this subject to those geologists who are now engaged in geological surveys of the various States, since it has a very important bearing on the history of soils.

Agriculturists will perceive, on examining their farms, that it often happens, that the rocks found there, are strangers to the place, and, on closer examination, they find that they can be identified with rocks farther north. Now

soils would be carried to much greater distances, and it would be interesting to know how far the various sedimentary substances were transported.

After making such a collection, it is necessary, next, to make careful chemical analyses of various kinds of soil, and to compare their composition with those known to be remarkable, the composition of each being accurately determined. By such comparisons, it will be evident on what principles the fertility or barrenness of a soil depends, and it may then be easily and certainly amended by supplying the materials found to be wanting, or by removal, or chemical change of those that are noxious to vegetation.

I have the honor to be,

Respectfully, your ob't. servant,

CHARLES T. JACKSON,

Geological Surveyor of Public Lands.

Boston, March, 25th, 1837.